Surface and Volume Mesh Quality Improvement

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Improvement of the quality of unstructured meshes is an important problem since a good quality mesh is an essential prerequisite for obtaining an accurate finite element or finite volume solution. In this research, procedures have been developed for the optimization of the quality of unstructured surface and volume meshes based on the condition number quality measure. The procedures, called Reference Jacobian based Mesh Optimization, are designed to improve the geometric shape of mesh faces and regions while keeping the improved mesh as close as possible to the original mesh. Special techniques using local element based parameterizations are incorporated into the procedures by which boundary nodes are repositioned such that they remain on the original discrete surface. The method has been found to improve the quality of elements on external boundaries, material interfaces and in the interior while preserving mesh features and surface characteristics.